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Learning to Use Innovative Pedagogy: The Experience of a Primary Science Teacher in Pakistan

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ABSTRACT *This study examined the experiences of primary science teachers when they were exposed to a new and innovative teaching strategy and the process that they followed in using the strategy in the classroom for the first time. Four primary science teachers, among the 22 participants of an 8-week Certificate in Education (Science) in Karachi, were observed and interviewed after the four-day teaching session where they were instructed how to use "Discrepant Events" to teach science content. Only the case of Farhana Batool, a teacher in a private school, is presented. Analysis shows that she went through at least three stages that were termed (a) "wow and vow" stage, (b) "muddling through" stage and (c) the "second thoughts" stage. The challenge for teacher educators is to design and implement teaching strategies where the teachers can undergo 2-3 cycles of the "muddling through" stage and to finally integrate these new ideas into their pre-workshop repertoire of teaching tools.*

KEY WORDS: *Teaching Strategy, Teacher Education, Science Education*

Introduction

As a teacher educator and a teacher-researcher, I am interested in professional development of teachers. I am particularly interested in the experiences that teachers undergo when they are exposed to a new and innovative teaching strategy for the first time. This study was initiated to look critically at the experience of primary science teachers taking part in the Certificate in Education in Science (CE-Science) offered by the Aga Khan University, Institute for Educational Development (AKU-IED), Karachi. The main question of the present study was as follows: What is the experience of primary science teachers when they are exposed to a new teaching strategy and the process that they follow in using the strategy in the classroom for the first time? The four-member teaching/research team undertook to develop four independent case-studies under the leadership of the author. Only the case of Farhana Batool[1], a primary science teacher in a private English school in Karachi, is presented here.

AKU-IED was established in 1993 as part of the Aga Khan University. The Institute's programmatic activities include a PhD programme in Education, a two-

1 A pseudonym has been used to protect the teacher's identity.

year Master of Education and inservice Certificate Programmes. The Certificate in Education is an eight-week inservice programme offered in five curriculum areas (science, mathematics, English, social studies, and primary education). The CE-Science is offered almost every year to primary and secondary science teachers. I have been associated with five such programmes taking a lead role in developing two of them. AKU-IED teacher education programmes are open to teachers from three kinds of schools: government, private and those belonging to the Aga Khan Education Services (AKES). The AKES schools are spread over eleven countries[2] hence, AKU-IED programmes not only have national impact, but they also affect the region as a whole.

One of the objectives of CE-Science is to expose science teachers to new and innovative teaching strategies in science, following constructivistic approaches to teaching and learning. One promising approach is through the use of 'Discrepant Events' (Halai & Wheeler, 1996; Kavogli, 1992; Mustafa, 1998). Discrepancy refers to a dissonant situation, where the outcome is contrary to what the learner expects. This usually results in arousal of conflict with a consequent need for the learner to assimilate or even accommodate the unknown or incongruous material into his or her cognitive structure. This concept of discrepancy can be traced to the early work of Festinger (1957) and his theory of Cognitive Dissonance, where he stated that the creation of dissonance is psychologically very uncomfortable and motivates individuals to actively reduce the level of dissonance and thereby return to a state of greater equilibrium or consonance.

Hence, Discrepant Event entails using activities in the science classroom that are counter intuitive and puzzle the students. Through the activity the teacher helps to create in the student a strong desire to resolve the discrepancy and seek an explanation for what is happening. It is claimed that this strong motivation enhances learning. Mustafa (1998) shared her experience of working with this strategy in a Pakistani science classroom, "I found the Discrepant Event strategy very useful and motivating. However, it was time consuming and difficult to implement. I had difficulty in developing events suited to the learning needs of the students" (p. v). Despite the difficulty, Shakoor (1998) considered the strategy to be viable in the science classroom in Pakistan. Shrigley (1987) reported that it fascinated children and that it could and should be used to teach inquiry-based science to children. Hence, this strategy is included in the repertoire of strategies introduced to teachers enrolled in the CE – Science.

Methodology

Since the purpose of the study was to develop an understanding of the process of teaching and using a new and innovative teaching strategy to teach science, a qualitative approach was considered to be more appropriate. As most of the teaching at AKU-IED is conducted in teams, it allows more space for tutors to conduct research regarding their own practice. The four members of the teaching team were encouraged to develop four independent case-studies in an effort to better

2 The countries in alphabetical order are: Afghanistan, Bangladesh, India, Kenya, Kyrgyzstan, Pakistan, Syria, Tajikistan, Tanzania, Uganda, and Uzbekistan.

understand their own practice. The research participants were drawn from the 22 teachers taking part in CE-Science. These teachers could be categorized into four groups. Teachers from government, private, and AKES schools in Pakistan. The fourth group comprised of teachers from the region that AKU-IED serves, particularly East Africa. One teacher representing each sector was selected to participate in the study. The criteria used to select the four teachers were the following:

- The teacher must have a science background, i.e., must have a BSc Degree or have taken science courses in high school;
- The teacher should be teaching science at the primary level when admitted into the programme;
- The teacher should have at least three years of teaching experience;
- The teacher should be doing well in the inservice programme.

All the four teachers that were selected volunteered to participate in the study. They were not treated differently from the other participants of the programme. An individual interview was conducted with the four teachers. Each interview was conducted after practice teaching in the classroom on the third day of the teaching sequence and lasted 30-45 minutes. As part of CE-Science, all teachers were also expected to maintain and share with the teaching team a reflective journal. The participating teachers' journal entries were also considered as part of the data. Hence, though direct data collection spread over the four-day period during which the primary science teachers were exposed to the strategy of teaching science by using Discrepant Event, each teacher's journal and the interviews allowed access to a greater range and depth of data. All quotes from these sources have been minimally edited to enable the reader to better understand the meaning. In addition, different national language words that Farhana used in her conversation have been translated into English.

The schedule that was followed for teaching and research was as follows:

DAY 1: The four-member teaching team spent the whole day teaching the topic of atmospheric pressure using appropriate Discrepant Events. Besides their teaching responsibilities, the research team also observed their designated teacher as part of the study, and took brief field notes which were later filled.

DAY 2: The teachers developed a lesson plan to teach science in a primary classroom of a local school, using the Discrepant Events strategy. Prior to their teaching, the participants had to be involved in a 15-minute microteaching session to demonstrate the strategy to their peers and obtain feedback. Each member of the research team continued to observe the designated teacher as part of the study and take brief field notes.

DAY 3: Each teacher taught the designated lesson in a real classroom, while being observed by a member of the teaching team. After the lesson, teachers were given feedback related to their performance. The research team maintained comprehensive field notes of the observed classes.

DAY 4: The teachers reflected on their teaching experience and revised their lesson plans in light of their experience. The research team individually interviewed the participating teachers for 30-45 minutes after class time.

The teaching format outlined above was generally followed by the teaching

team throughout the eight weeks of the programme. Farhana has summed it up as follows in her interview:

> *There is a basic thing, which I have observed. You have special way to move ahead that I have been observing from the first day. Whenever we learn something new, first of all you demonstrate it such as a teaching strategy, which we have not studied before. We observe, then on the same topic keeping in mind our experience, we plan something ourselves. After that we present it to our peers, which helps to build confidence, and then we implement the plan in a classroom.*

Support and help was provided to the teachers throughout the planning and development stage of their lesson plans. The whole lesson was observed by at least one member of the teaching team. Data for the study was collected in the form of field notes and reflective journal entries maintained both by the participating teachers and by the research team. The teacher was also interviewed for 30-45 minutes. The interviews were audiotaped and transcribed for in-depth analysis.

Data analysis involved reading thoroughly and coding the field notes, the reflective journal entries, and the transcribed interviews. Comments, remarks, and emerging categories were noted in the margin. Patterns and trends in these materials helped to identify relationships between variables and themes. Isolating these patterns and processes, and collapsing them in large categories enabled the findings to emerge.

Teaching and Learning a New Teaching Strategy

Farhana Batool is a bright and articulate science teacher working in a private school in Karachi, which I shall call the Central Model School (CMS). She recently shifted to Karachi from another city and started teaching at CMS. She was sponsored to participate in the inservice programme although she had been working in the school for only four months. She was considered eligible for the program because of her ability to benefit from it and her willingness to invest time and effort during the program. During the CE-Science, she participated whole-heartedly asking questions and raising issues both during class and in her reflective journal. She had the ability to grasp new ideas relatively quickly and was a very conscientious teacher.

Learning about Discrepant Events

Farhana was not aware of Discrepant Event as a strategy for teaching science. When she first noticed it in the teaching schedule, she like other teachers expressed her astonishment. When the strategy was demonstrated to the teachers, they expressed mixed feelings. Farhana's first reaction to the use of this strategy by the teaching team was articulated in the interview as follows:

Farhana: First day when the activity comes, you have a feeling that Discrepant Events are something else! These activities will not be from those activities that we do daily. These are something else. An the beginning, we had a discussion, then one activity was done in front of us, we also did an activity by ourselves. Till that time, it appeared that Discrepant Event activities are something else.

Author: What does it mean "something else"?

Farhana: It comes to my mind that Discrepant Events are not normal activities.

Author: OK.

Farhana: They are something special. They are something different. We will have to consult some different books. In the beginning, it appeared that it was going to be a difficult task. When we started lesson planning, thought more, picked up and read more books, then it became clear that discrepancy is present in almost all activities. Majority have them! But, we don't think in that way. It has more to do with the way we think. In which direction are we going? Most helpful were the suggestions we got to improve the Discrepant Event from our peers and tutors... For me, the ideal time was that time.

Author: When your peers...

Farhana: When we were doing the microteaching for other teachers, when we talked the confusion automatically came forward, and we ourselves became more clear about the activity and where we should improve it. That really helped us a lot. And we automatically became more confident. If things have worked here, then definitely it would work in the classroom.

The content atmospheric pressure and related concepts were to be taught using this strategy. As part of the morning's session, teachers in groups of four had to work on pre-selected Discrepant Events, illustrating some aspects of atmospheric pressure. Each group was to then present to the rest of the class both the activity and the science underpinning the activity. Farhana's group was given an activity, where they were supposed to put a lighted matchstick in a jam jar, and close the jar using in such a way as to seal it airtight, using one's hand. When the jar was released, it was expected to remain stuck to the hand. Farhana tried it several times, but she could not do it. Then Farid, another teacher in her group, tried his hand at it. It worked very well. The jar remained stuck to his hand for quite some time leaving a dark red ring mark on his hand. He said that he felt suction on his palm too. However, all subsequent attempts to obtain the required suction failed, and the jar did not "stick" to the hand. Farid and then Farhana both tried it together with a third teacher from the group, but it did not work. The jam jar refused to stay stuck to the hand , as it had during the first part of the group work. During the session, where they had to demonstrate this activity to the whole class, they made the best effort to show it should have worked.

Two things were of interest to me. First, the fact that the selected activity sometimes worked and sometimes did not, and secondly, a very cursory attempt was made to explain the science behind the event. In this case, it is likely that the teachers did not try to explain the science behind the Discrepant Event, because the activity did not work. Similarly, other groups were expected to demonstrate their Discrepant Event to the rest of the class and teach the scientific concepts underlying it. However, only one group took some pains at trying to get at the underlying scientific concept. At the end of the morning sessions, I was not sure how many teachers had understood the concept of atmospheric pressure from the demonstrations. Retrospectively, I think we, the teaching team, should have encouraged and actively facilitated that to happen. We focused more on the activity rather than on teaching the content, and we realized that the teachers also focused on making the activity work and less attention was paid on understanding/explaining the science underpinning the event. For instance, the focus was on making the jar stick rather than on understanding and explaining to their peers the reason behind it.

The teachers were also at different levels of comfort when working with this strategy. There were some teachers who could not understand the concept of dis-

crepancy, had difficulty in identifying the discrepancy in most of the planned activities, and there were those who wanted to create a discrepancy themselves and succeeded. Farhana was among the teachers who used the strategy of "Discrepant Events" successfully.

Teaching Through Discrepant Events

On the second day the teachers were given time to look up resources in the library to prepare their lesson plan using a Discrepant Event. I was immediately surrounded by a group of teachers who wanted more specific help. I suggested some books for consultation including Liem's book "Invitation to Science Inquiry (1987)". The teachers went to the library to get their hands on the books. I saw Farhana and one of her colleagues in front of the photocopier in the afternoon. They were getting some materials copied. I asked them how they had located the most appropriate Discrepant Event for their teaching. They told me that they looked for an activity that they could do easily with readily accessible materials then looked in the textbook to see the absence or presence of that topic and then they came up with an objective for the lesson.

In essence the sequence was exactly same as the one that we as the teaching team had followed in planning this session and also interestingly it is also the exact opposite to what we profess to teach, i.e. make the objectives first and then develop the lesson. In the original plan for the inservice the week of the study was set aside for teaching biological content using Discrepant Events. However, we found very few Discrepant Events suited to teaching biology and even fewer resource materials that could be used to help develop the events. Hence, it was decided to teach atmospheric pressure, as there was much more material and doable activities available on this topic. Does it mean that in some strategies like the Discrepant Event it is easier to first locate the activities and resources and then select the topic area? Is there any harm in following this practice?

Farhana selected a Discrepant Event to help teach the concept that hot air rises to set up convection currents based on a number of factors. She explained the selection process in this way:

> *To plan the lesson I had to find the activity with the topic in mind. For that I had to go to the library and read trying to find different activities, reading them thoroughly and then thinking about them. Some of the activities that I read were very general which the children would already know. So I dropped that activity. Some activities that I selected on closer inspection were not relevant. That is I would not be able to take out the relationship between the activity and the topic to be taught. Then there were some good activities but to explain them would require a high level of understanding in science and hence would be inappropriate for class four. I was also looking for those activities that needed materials I could get myself. Neither did I want to borrow materials from IED nor did I want to purchase them. So I did keep the materials in mind too. Maybe the materials I want to use are available at IED but not in my school so I wanted to develop an activity that I could easily support anywhere.*

She had first selected another activity that she tried to prepare at home. However, despite repeated attempts she could not get the desired results. Hence, the next morning after consulting with the teaching team she changed the activity

and quickly prepared for the microteaching session. Farhana taught her lesson to class four in the CMS school for one period lasting one hour. The Discrepant Event she used to show that hot air rises is described in Figure 1.

Take three bottles from which the bottom has been cut away.

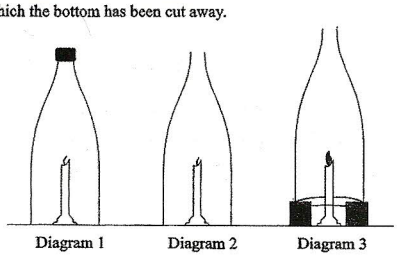

Diagram 1 Diagram 2 Diagram 3

First light a candle and cover it with the plastic bottle as shown in Diagram 1. Make sure that the top of the bottle is tightly closed with the cap. The candle will soon extinguish.

Light another candle and cover it with a bottle, as shown in Diagram 2, make sure that the cap is removed. Even now the candle will extinguish very soon, which comes as a surprise!

Light the third candle and cover it with the third bottle, as shown in Diagram 3. Make sure that the bottle is raised higher by placing it on small wooden pegs. The candle will continue to burn for a long time.

Figure 1. An Example of Discrepant Event

Her lesson was very successful in that it achieved the main objective of letting the children see that hot air rises. Her management of the class and the materials was excellent, though initially she faced some difficulty in making the demonstration visible to all studens. However, the best part of the lesson was the manner in which she had used the Predict Observe Explain (Woolnough, 1991) sequence of questioning to enhance student engagement and suspense. However, she felt that she could do better by devising an lesson where the students could in groups work on a Discrepant Event themselves.

During the interview when Farhana was asked the most essential and critical elements for using discrepancy in the primary classroom she said:

> *Content knowledge is the most essential. Without having content knowledge whatever method we use (will not work), because we cannot question the children. Till the time we are not clear, we definitely cannot ask questions with confidence. This is my own experience. If I have to ask questions so that children are encouraged to ask more questions, then I will hesitate to go on a track where I am not sure of my own content knowledge. But when we are confident we want the child to think more, ask more questions. Content knowledge is the basic requisite of good teaching.*

Understanding of the Process

Analyzing the process from the first exposure to the last stage where the teachers reflected on their own teaching, I find that Farhana went through at least three stages:

1. The appreciation and resolution stage which I have called the wow and vow stage!
2. The application stage which I have called the muddling through stage
3. The analysis stage which I have called the second thoughts stage

In the first stage Farhana was delighted with the presentation made by the teaching team - she called it almost magical. She was fascinated by the activities pre-

sented, the manner in which it was presented to create disequilibrium in her mind and the way it was resolved by teaching the content. She also resolved to teach in a similar manner. I have called this the *wow and vow* stage.

The second stage comes into play where a teacher like Farhana is given time to develop her own lesson plan using this strategy. Immediately, there is almost a sense of panic and she with her colleagues is seen in the library and at the photocopier making copies of potentially suitable activities. Then she came to the teaching team asking for suggestions to better match the activity to her teaching goals. I also saw her answering a lot of questions from her colleagues. A number of them are huddled around her asking help in trying to understand some instructions for an activity sheet that they had brought from the library. Both peer and faculty support is essential during this stage. During this time Farhana made two decisions that helped her to succeed. She decided on a topic and did not change it even if the activity that she had selected did not work. She chose to select another activity covering the same topic rather than change the topic and the activity. This is where a number of her colleagues had difficulty. As soon as an activity did not work they panicked and chose another activity that they thought would work unmindful of the topic area. That meant that not only did they have to work on a new activity they had to read up and understand a new topic area.

It is well known that science teachers, particularly at the primary level, are not confident about their science content knowledge and need support in that area (Asoko, 2002; Kruger & Summers, 1988). Farhana was well aware of this and hence made sure that she mastered the content area that she was to teach by working independently in the library and approaching the teaching team to guide her to appropriate resources. At least twice she came with specific questions regarding the content she was teaching. The confidence in her own abilities enabled her to approach the teaching team a number of times for help and support. She also had the ability to work independently. Many other teachers in the CE-Science did not have the confidence and the skills to use both, the human and other resources made available to them in the inservice, to their best advantage. In fact Farhana was often surrounded by other teachers who sought her help in planning the lesson. We encouraged peer coaching of this kind as once they the teachers returned to their own schools this might be one of the best ways to get support for teaching in innovative ways.

The last stage was the stage where Farhana had second thoughts about her ability to engage and use this strategy in her own classroom. She wrote in her reflective journal:

> *There is a question in my mind. Here at IED we have time, books and guidance of our facilitators to help us to plan and deliver an effective lesson. Is it really going to work when we go back to our own places? There we have a lot to do and in one day we have to take three or four lessons. I think we are really going to have a tough time. Although we did all the work individually today, but we faced a tough time in preparing our lesson. A lot of practice will be required to overcome this problem.*

Implications for Teaching

The first stage of wow and vow is very important for motivation of the teachers, but it is the second stage of muddling through that defined success for Farhana.

She needed the time and space to work on her activity and materials. However, support and pressure both are required at this stage – if no support is provided at this stage both from the peers and from the teaching team the teacher would soon become frustrated trying to do a task for which she/he is not well prepared. However, if there was no pressure it is possible that Farhana might have not been able to prepare another activity to replace the first one in such a short time. The pressure was provided in two ways, (a) by expecting teachers to prepare a lesson and micro-teach a part of the lesson to their colleagues and (b) by requiring the teachers to teach in a real classroom. Farhana reiterated again and again in her interview that this aspect of the whole teaching sequence was most helpful in clarifying ideas, removing confusions and improving the lesson planned.

The biggest challenge for teacher educators is to devise means where the teacher can undergo two or three cycles of the muddling through stage – each iteration would help them to get closer to the stage which Bonnsetter (1998) has called the phase III. He states that teachers go through three phases as they try to implement reform in education:

Phase I: The pre-reform stage where the teacher is "doing what you have been doing."

Phase II: The teacher is exposed to a new way of doing something via a one-day workshop. S/he tries it out and it does not work and s/he concludes "this stuff is just another short term educational trend". And they revert back to phase I.

Phase III: The teachers do not stay long enough with the reform to reach the phase III where teachers reflect on what they are doing and how they might integrate these new ideas into their pre-workshop repertoire of teaching tools.

To keep the teacher engaged with a new strategy until he becomes comfortable using it, overcomes the accompanying second thoughts, is the challenge that is facing teachers educators at AKU-IED too. One of the reasons that the Certificate in Education has transformed into a more field-based format is to extend and lengthen the Phase II and support the muddling process so that the teachers reach the Phase III.

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